Claims

1. A radio communication method by which radio communication apparatuses transmit beacons using beacon periods so that the beacons do not conflict with one another, comprising:

a detection step in which a radio communication apparatus detects whether in the beacon period there are empty beacon slots before the beacon slot which is the period for transmitting beacons of that radio communication apparatus,;

a step in which, when such empty beacon slots are detected in the detection step, the radio communication apparatus starts count of a specified number of super frames after which the beacon slot of the radio communication apparatus will be moved to one of the empty beacon slots;

a step in which the radio communication apparatus adds to a beacon moving status information for notifying the other radio communication apparatuses of the beacon slot movement processing state of the radio communication apparatus and also adds to the beacon beacon period occupancy information that consists of moving status information received from the other radio communication apparatuses, identifiers for specifying the radio communication apparatuses sending the moving status information, and a beacon slot position, which are linked, and transmits the beacon at the beacon slot of the radio communication apparatus; and

a step in which, after elapse of the specified number

of super frames, the radio communication apparatus moves its beacon to the empty beacon slot and transmits the beacon.

2. A radio communication method according to claim 1, characterized in that the countdown of a specified number of super frames is not performed in a period in which beacons of the other radio communication apparatuses are present from the beacon slot of the radio communication apparatus in question until the end of the beacon period.

3. A radio communication method according to claim 1, characterized in that the specified number of super frames is at least 2

4. A radio communication method according to any one of claims 1 to 3, characterized in that, when the radio communication apparatus detects a change of beacon formation, that is, the arrangement of beacon slot positions of the radio communication apparatus, by checking the beacon and the beacon period occupancy information received by the radio communication apparatus, the radio communication apparatus performs detection of an empty beacon slot and movement processing for moving its beacon slot position to the empty slot.

5. A radio communication method according to claim 1,

characterized in that the moving status information is a counter value of a movable counter that counts the specified number of super frames or a flag.

6. A radio communication method according to claim 4, characterized in that the radio communication apparatus secures at least the lowest two slots of the beacon formation as entry slots not performing data communication and, in the start transmission of a beacon with a radio communication apparatus joining a radio network anew or again, transmits the beacon at a slot selected at random from among these entry slots, this becoming the beacon slot position of the radio communication apparatus.

7. A radio communication method according to claim 6, characterized by further comprising a step in which to a beacon, the radio communication apparatus adds beacon slot length information that indicates the length of the period down to the lowest slot of the beacon formation recognized by the radio communication apparatus, and in that

the radio communication apparatus receives beacons but does not perform data communication in a period calculated by adding the entry slot length to the maximum beacon slot length found from the beacon slot length information received from neighboring radio communication apparatuses.

8. A radio communication apparatus comprising:

a beacon receiving unit that receives a beacon and extracts a frame;

a frame judging unit that judges whether the extracted frame is a beacon frame and records beacon period occupancy information that consists of the reception slot position of the beacon, an identifier specifying the radio communication apparatus that transmitted the beacon, and moving status information indicating whether the radio communication apparatus that transmitted the beacon is moving its beacon slot position, which are linked, and also records the beacon period occupancy information included in the beacon frame;

a beacon slot position control unit that sets, when empty beacon slots before the beacon slot of the radio communication apparatus are detected in a beacon period by checking all the beacon period occupancy information recorded in the recording unit, the counter value in a movable counter of the specified number of super frames until the beacon slot of the radio communication apparatus is moved to the empty beacon slot, and commands change of the beacon slot position of the radio communication apparatus in response to a notice of completion of countdown from the movable counter;

a beacon transmission command unit that detects its own slot position that had been determined by the beacon slot

position control unit, and orders transmission of a beacon; and

a frame forming unit that forms, in response to the instruction from the beacon transmission command unit, a beacon frame including the beacon period occupancy information generated from the received beacon, moving status information of the radio communication apparatus, and beacon slot length information indicating the total length of beacon slots calculated from the beacon received by the radio communication apparatus.

9. A radio communication apparatus according to claim 8, characterized in that the movable counter does not perform the count of the specified number of super frames in a period in which beacons of other radio communication apparatuses are present from the beacon slot of the radio communication apparatus in question until the end of the beacon period.

10. A radio communication apparatus according to claim 9, characterized in that the specified number of super frames is at least two or more.

11. A radio communication apparatus according to claim 8, characterized in that, when the beacon slot position control unit detects a change of beacon formation, that is, the

arrangement of beacon slot positions of the radio communication apparatuses, by checking the received beacon and the beacon period occupancy information, the beacon position control unit performs detection of an empty beacon slot and movement processing for moving its beacon slot position to the empty beacon slot.

12. A radio communication apparatus according to claim 8, characterized in that the moving status information is a counter value of a movable counter that counts a specified number of super frames or a flag.

13. A radio communication apparatus according to claim 8, characterized in that the frame forming unit secures at least the two lowest slots of the beacon formation as entry slots not performing data communication, and

in the start of transmission of a beacon by a radio communication apparatus joining the radio network anew or again, the beacon slot position control unit instructs the beacon transmission command unit that a slot selected at random from among the entry slots is the beacon slot position of the radio communication apparatus.

14. A radio communication apparatus according to claim 8, characterized in that the frame judging unit receives a beacon

during a period that is calculated by adding the length of the entry slots to the maximum beacon slot length found in the beacon slot length information received from neighboring radio communication apparatuses, and

the frame forming unit does not perform data communication during the period.

15. A radio communication method according to claim 1, characterized in that the moving status information further includes movement destination slot position information indicating the planned movement destination of the beacon slot position of the radio communication apparatus, and

when the radio communication apparatus detects that there is a empty beacon slot other than the beacon slots designated by the movement destination slot position information of the other radio communication apparatuses which transmit their beacons during the time from the beacon slot of the radio communication apparatus in question until the end of the beacon period, the radio communication apparatus selects any one of these empty beacon slots, notifies the other radio communication apparatuses that this empty beacon slot will be the movement destination beacon slot position of the radio communication apparatus in question, and starts count of the specified super frames.

16. A radio communication method according to claim 15, characterized in that, when the radio communication apparatus selects the highest empty beacon slot, if the radio communication apparatus is not in the lowest slot, the radio communication apparatus repeatedly selects the next highest empty slot in the next super frame until the radio communication apparatus is in the lowest slot.

17. A radio communication method according to claim 15, characterized in that the radio communication apparatus selects an arbitrary beacon slot among the empty beacon slots.

18. A radio communication method according to claim 1, characterized by comprising a step in which the radio communication apparatus detects, when the counter value of the radio communication apparatus is the maximum value while the radio communication apparatus is counting the specified number of super frames, other radio communication apparatuses are found to have the maximum counter value from the moving status information or other radio communication apparatuses are found to have the maximum counter value from beacon period occupancy information, or when the counter value of the radio communication apparatus is the maximum value -1, other radio communication apparatuses from the moving status information, and, when the counter value of the radio communication apparatus is neither

the maximum value nor the maximum value - 1, other radio communication apparatuses having the identical counter value from the moving status information, or other radio communication apparatuses having a value of the counter value + 1 from the beacon period occupancy information, and in that

when the radio communication apparatus detects radio communication apparatuses satisfying any one of the above conditions, the radio communication apparatus in the lowest slot position among the radio communication apparatuses continues the count and the other radio communication apparatuses are reset to the specified counter value.

19. A radio communication method according to claim 18, characterized in that, when the radio communication apparatus receives the beacon period occupancy information of another radio communication apparatus having the maximum value or a counter value identical with the counter value of the radio communication apparatus in question other than 0 during counting, the radio communication apparatus stops the count and resets the counter value of the radio communication apparatus to the maximum value.

20. A radio communication method according to claim 1, characterized in that the empty beacon slot which is the movement destination of the beacon slot of the radio communication

apparatus is the highest empty beacon slot.

21. A radio communication apparatus according to claim 8, characterized in that the moving status information further includes movement destination slot position information indicating the planned beacon slot movement destination of the radio communication apparatus, and

when there is an empty beacon slot other than beacon slots designated by the movement destination slot position information of the other radio communication apparatuses that transmit beacons during the time from the beacon slot of the radio communication apparatus in question until the end of the beacon period, the beacon slot position control unit records moving status information, that the empty beacon slot is planed as the beacon slot movement destination, of the radio communication apparatus in the recording unit and sets the specified count in the movable counter, and

the frame forming unit forms a beacon frame including the moving status information of the radio communication apparatus recorded in the recording unit.

22. A radio communication apparatus according to claim 21, characterized in that the beacon slot position control unit designates the highest empty slot other than beacon slots to which other radio communication apparatuses which transmit

beacons during the time from the beacon slot of the radio communication apparatus in question until the end of the beacon period, plan to move, as the movement destination beacon slot.